

Naval Biodynamics Laboratory  
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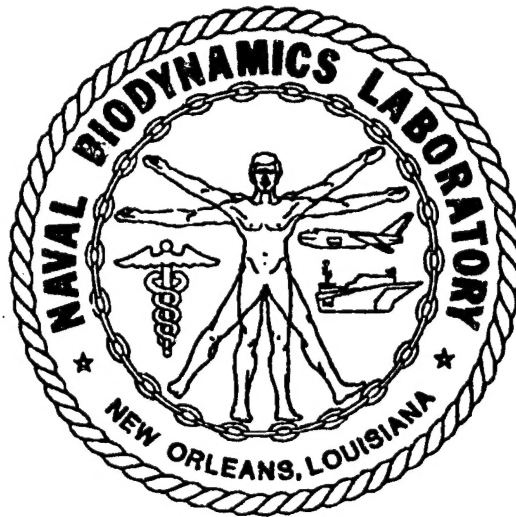
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**PHOTOGRAMMETRIC TASKS FOR +Z VERTICAL  
ADDED HEAD MASS EXPERIMENTS**

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Final Technical Report

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Prepared for

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***Photogrammetric Tasks For +Z Vertical  
Added Head Mass Experiments***

***GPA Associates***

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**Contract Number: N00205-91-M-G011**

## **Photogrammetric Tasks For +Z Vertical Added Head Mass Experiments**

The location and orientation of the head and body anatomic coordinate systems are essential for the analysis of acceleration data to determine forces and torques on the test subjects (Human research volunteers or HRVs). A new method was proposed to analyze the x-rays using very powerful photogrammetric techniques and to utilize the new Altek digitizing tablet.

The GIANT preprocessing program PREP was rewritten to accommodate input from the tablet. Two scripts were made for each of the two sets of x-rays.

### **Head Anatomic Coordinate System**

Four x-rays were taken of each HRV, the two normal (A/P & Lateral) and two more but with the HRV rotated outward about 45°. In addition, two x-rays were made of the calibration prism for object space control. The new x-rays at 45° provided additional data to guarantee an over-determined solution for the photogrammetric system (GIANT) to process. Additional bb's were placed on the subjects in various places to improve the solutions (reduce the size of the error ellipsoids). The necessary characteristics for the added bb's were that they were immobile during the series of x-rays and that they tended to cover the field of view of the x-ray.

The six x-rays were separately digitized according to a fixed script (see appendix 1) within the program ALTHEAD, which created a 6-photo IMG.DAT file for GIANT. Only four of the six were different. The calibration x-ray images after pre-processing were merged with those of the corresponding normal (not rotated) A/P & lateral x-rays.

A full sample GIANT output is given in appendix 6 for one of the HRVs and the anthropometry output for all the HRVs is in appendix 4. Combined with neck data to be discussed, appendix 3 has the complete results in EZFlow format.

Typical errors in the determination of the essential anatomic points was approximately 1mm, about the limit one might expect consistent with the limitation of the geometry, the size of the bb's and other measurement errors.

### **Body Anatomic Coordinate System**

The body anatomic system defied efforts to establish the same rigor. Prior efforts had none of the vertebral points on more than one x-ray. Their locations in space required some manipulation and assumptions relating their locations to external bb's and to the x-ray focal point(!). Photogrammetric techniques require two points for a minimum and preferably three or more.



Lateral x-rays are obscured by the large mass through which they must pass. Locating an object requires two or more non-collinear determinations. Therefore, a stereo pair was taken in the A/P direction. The superior corner remained invisible-washed out. Rotating the HRV about 25° resulted in the stereo pair being readable but not by everybody. Some experience seems if not essential at least helpful.

A new script (appendix 2) was written into PREP and called ALTBODY for the digitization of the body x-rays. The processed images were fed into GIANT. The error ellipsoids showed peak uncertainties in the direction of the x-ray tube of about 12cm(!). The stereo angle was definitely too narrow. Increasing the angle between the photos makes it even harder to bring the two stereo images together. The alternative was to use another stereo pair with the HRV rotated in the other direction. Each pair yielded the same 12cm error separately but together the error dropped to about 4-5mm.

A sample GIANT output for the body system is given in appendix 7, whereas the full anthropometric output portion for all the HRVs is in appendix 5 and is combined with the head data in EZFlow format in appendix 3.

The body results (errors) still lag behind the head data for several reasons:

The internal points are still difficult to see and identify. What one sees as the spinous process and some other points when the body is rotated in one direction is not quite what one sees for the opposite rotation-perhaps a point slightly shifted around the curve.

The sternum bb moves as the HRV breathes. Shoulder bb's are determined by posture as are the bb's on the neck. Usually these are close enough for each stereo pair, but not always. Often rotating the HRV changes the posture moves these through large distances:

IneckB (0.0648, -0.0068, 0.1775) vs. (0.0641, 0.0016, 0.1791) m  
IneckT (0.0535, 0.0343, 0.1886) vs. (0.0580, 0.0458, 0.1766) m

## RECOMMENDATIONS

It was recommended that a lucite posing chair be constructed into which the HRV would be strapped in a manner similar to the actual sled runs. If it could be rotated and translated instead of moving the HRV relative to the chair, much of the errors obtained might be reduced. Such a chair is now under construction.

X-Ray Anthropometry Digitizing Script

FIDUCIALS	CALIBRATION PRISM	HRV HEAD
1	'c3' or 'c5'	'lam'
2	'c13'	'ram'
3	'c4' or 'c8'	'lon'
4	'c11'	'ron'
5	'c10'	'ltp'
6	'c9'	'rtp'
7	'c2' or 'c6'	'ctp'
8	'c12'	'chin'
9	'c1' or 'c7'	'ltuskF'
10	'cv1'	'ltuskM'
	'cv2'	'ltuskR'
	'cv3'	'rtuskF'
	'cv4'	'rtuskM'
	'cv5'	'rtuskR'
	'cv6'	'capLff'
	'cv7'	'capLfR'
	'cv8'	'capRtF'
	'cv9'	'capRtR'
	'cv10'	'capCEN'

(These are followed by 1st non-zero fiducial)

1	5	7	cv1	2	3	4	5
2		8	c3(5)	13		4(8)	
3		9	c11	10		9	
4	6	10	c2(6)	12		1(7)	
			cv6	7	8	9	10

1	2	3	-4----->
			-1----->
			-2----->
			-3----->
			-5----->
V	V	V	

.....  
ALTEK DIGITIZER 4-BUTTON KEY CONTROL MEANINGS:

#2:RED=ERROR-BACKUP

#4:BLUE=???

#1:YELLOW=MISSING

#3:GREEN=FIDUCIAL or DATA POINT

.....

# X-Ray Anthropometry Digitizing Script

FIDUCIALS	Locations of Fiducials				Order of digitization
1	7			10	
2		8	9		
3					--3----->
4					
5	5			6	--2----->
6					
7					--1----->
8	1			4	
9		2	3		
10					

HRV BODY	Approximate locations on x-rays			
'origin'				
'lf_rib'	rneckT		lneckT	
'rt_rib'				
'top_spin'				
'bot_spin'				
'spine_bb'		rtp	ctp	ltp
'sternum'				
'lf_shold'	rneckB		lneckB	
'rt_shold'		rt_rib	lf_rib	spine_bb
'ltp'			top_spin	
'rtp'			bot_spin	
'ctp'		origin		
'lneckT'				
'lneckB'				
'rneckT'				
'rneckB'	rt_shold	sternum		lf_shold

(These are followed by 1st non-zero fiducial)

.....  
ALTEK DIGITIZER 4-BUTTON KEY CONTROL MEANINGS:

#2:RED=ERROR-BACKUP

#4:BLUE=???

#1:YELLOW=MISSING

#3:GREEN=FIDUCIAL or DATA POINT  
.....

# ANTHROPOMETRY OUTPUT IN FORM FOR EZ-FLOW

H00222	MAR 91	HEAD DATA
15.0758	0.4458	-1.5789
-0.564306	-0.021160	-0.825294
-0.065657	0.997655	0.019315
0.822950	0.065086	-0.564373
H00222	MAR 91	NECK DATA
-18.4226	1.4523	7.8292
0.998378	-0.053356	-0.019868
0.051853	0.996219	-0.069711
0.023513	0.068568	0.997369

H00226	MAR 91	HEAD DATA
15.3533	-0.0296	-1.6299
-0.558896	-0.013702	-0.829124
0.007833	0.999732	-0.021802
0.829201	-0.018680	-0.558639
H00226	MAR 91	NECK DATA
-15.2009	-0.9364	9.0198
0.975366	0.119443	-0.185460
-0.133935	0.988679	-0.067643
0.175280	0.090816	0.980321

H00227	MAR 91	NECK DATA
-19.8392	-2.7613	3.6425
0.977128	0.197335	0.079248
-0.193544	0.979657	-0.053037
-0.088102	0.036485	0.995443

H00235	MAR 91	HEAD DATA
15.7940	0.6722	-0.2051
-0.463656	-0.040465	-0.885091
-0.054751	0.998356	-0.016962
0.884322	0.040595	-0.465109
H00235	MAR 91	NECK DATA
-17.7137	1.1679	6.9586
0.993792	-0.076149	-0.081107
0.069104	0.993862	-0.086388
0.087187	0.080247	0.992955

H00236	MAR 91	HEAD DATA
14.7014	-0.2727	-0.7149
-0.544915	0.031293	-0.837907
0.030031	0.999391	0.017794
0.837953	-0.015467	-0.545523
H00236	MAR 91	NECK DATA
-17.8482	0.1340	6.5006
0.998851	-0.004147	-0.047748
0.004553	0.999954	0.008396
0.047711	-0.008603	0.998824

H00237	MAR 91	HEAD DATA
16.2832	-0.6640	0.0369
-0.413590	0.038658	-0.909642
0.057022	0.998237	0.016497
0.908676	-0.045047	-0.415065
H00237	MAR 91	NECK DATA
-17.6617	-0.3212	3.8235
0.990601	0.045063	0.129149
-0.041518	0.998687	-0.030017
-0.130332	0.024373	0.991171



H00240	MAR 91	HEAD DATA
14.5408	-0.1803	-1.0551

-0.563149	0.014527	-0.826228
0.013597	0.999873	0.008313
0.826244	-0.006553	-0.563275

H00240	MAR 91	NECK DATA
-18.9848	-0.1718	2.0138

0.982062	-0.037795	0.184733
0.028403	0.998178	0.053227
-0.186408	-0.047025	0.981346

H00241	MAR 91	HEAD DATA
15.8038	-0.4359	0.0998

-0.454264	-0.006159	-0.890846
0.058616	0.997603	-0.036787
0.888936	-0.068928	-0.452814

H00241	MAR 91	NECK DATA
-18.1043	-0.5658	5.8621

0.997620	0.068826	0.004151
-0.068312	0.994760	-0.076067
-0.009364	0.075602	0.997094

H00242	MAR 91	HEAD DATA
15.4861	-0.1765	-0.6569

-0.546887	-0.025832	-0.836807
0.024138	0.998622	-0.046603
0.836858	-0.045686	-0.545510

H00242	MAR 91	NECK DATA
-17.9545	-2.4086	4.2884

0.985006	0.117710	0.126123
-0.117294	0.993039	-0.010743
-0.126510	-0.004211	0.991956

H00243            MAR 91            HEAD DATA

14.6950	-0.1635	-0.6194
-0.540610	-0.018653	-0.841067
0.016261	0.999336	-0.032615
0.841116	-0.031308	-0.539947

H00243            MAR 91            NECK DATA

-17.1260	1.0928	4.3546
0.993706	-0.057820	0.095949
0.056713	0.998289	0.014230
-0.096607	-0.008698	0.995285

H00245            MAR 91            HEAD DATA

15.2708	-0.4895	-1.3856
-0.588311	0.010802	-0.808563
0.036007	0.999269	-0.012850
0.807833	-0.036674	-0.588270

H00245            MAR 91            NECK DATA

-19.5921	-0.1332	3.3402
0.985944	-0.020871	0.165767
0.016782	0.999520	0.026030
-0.166231	-0.022882	0.985821

H00246            MAR 91            HEAD DATA

15.4854	-0.1917	-2.4835
-0.602996	0.026833	-0.797293
0.028161	0.999527	0.012342
0.797247	-0.015010	-0.603467

H00246            MAR 91            NECK DATA

-17.5506	0.0605	5.9785
0.999634	-0.013221	-0.023598
0.013033	0.999882	-0.008112
0.023702	0.007801	0.999689

H00247            MAR 91            NECK DATA

-17.6736	0.3493	3.1673
0.978635	0.015629	0.205009
0.000959	0.996749	-0.080565
-0.205602	0.079040	0.975439

# HEAD ANTHROPOMETRY OUTPUT

HRV # 0222

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.0758cm Y= 0.4458cm Z= -1.5789cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.564306	-0.021160	-0.825294
-0.065657	0.997655	0.019315
0.822950	0.065086	-0.564373

HRV # 0226

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.3533cm Y= -0.0296cm Z= -1.6299cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.558896	-0.013702	-0.829124
0.007833	0.999732	-0.021802
0.829201	-0.018680	-0.558639

HRV # 0235

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.7940cm Y= 0.6722cm Z= -0.2051cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.463656	-0.040465	-0.885091
-0.054751	0.998356	-0.016962
0.884322	0.040595	-0.465109

HRV # 0236

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 14.7014cm Y= -0.2727cm Z= -0.7149cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.544915	0.031293	-0.837907
0.030031	0.999391	0.017794
0.837953	-0.015467	-0.545523

HRV # 0237

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 16.2832cm Y= -0.6640cm Z= 0.0369cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.413590	0.038658	-0.909642
0.057022	0.998237	0.016497
0.908676	-0.045047	-0.415065

HRV # 0240

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 14.5408cm Y= -0.1803cm Z= -1.0551cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.563149	0.014527	-0.826228
0.013597	0.999873	0.008313
0.826244	-0.006553	-0.563275

HRV # 0241

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.8038cm Y= -0.4359cm Z= 0.0998cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.454264 -0.006159 -0.890846  
0.058616 0.997603 -0.036787  
0.888936 -0.068928 -0.452814

HRV # 0242

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.4861cm Y= -0.1765cm Z= -0.6569cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.546887 -0.025832 -0.836807  
0.024138 0.998622 -0.046603  
0.836858 -0.045686 -0.545510

HRV # 0243

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 14.6950cm Y= -0.1635cm Z= -0.6194cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.540610 -0.018653 -0.841067  
0.016261 0.999336 -0.032615  
0.841116 -0.031308 -0.539947

HRV # 0245

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.2708cm Y= -0.4895cm Z= -1.3856cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.588311	0.010802	-0.808563
0.036007	0.999269	-0.012850
0.807833	-0.036674	-0.588270

HRV # 0246

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.4854cm Y= -0.1917cm Z= -2.4835cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.602996	0.026833	-0.797293
0.028161	0.999527	0.012342
0.797247	-0.015010	-0.603467



**T-1                    ANTHROPOMETRY    OUTPUT****HRV # 0222****T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN****X= -18.4226cm    Y= 1.4523cm    Z= 7.8292cm****T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM**

0.998378	-0.053356	-0.019868
0.051853	0.996219	-0.069711
0.023513	0.068568	0.997369

**HRV # 0226****T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN****X= -15.2009cm    Y= -0.9364cm    Z= 9.0198cm****T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM**

0.975366	0.119443	-0.185460
-0.133935	0.988679	-0.067643
0.175280	0.090816	0.980321

**HRV # 0227****T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN****X= -19.8392cm    Y= -2.7613cm    Z= 3.6425cm****T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM**

0.977128	0.197335	0.079248
-0.193544	0.979657	-0.053037
-0.088102	0.036485	0.995443

HRV # 0235

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -17.7137cm Y= 1.1679cm Z= 6.9586cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.993792	-0.076149	-0.081107
0.069104	0.993862	-0.086388
0.087187	0.080247	0.992955

HRV # 0236

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -17.8482cm Y= 0.1340cm Z= 6.5006cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.998851	-0.004147	-0.047748
0.004553	0.999954	0.008396
0.047711	-0.008603	0.998824

HRV # 0237

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -17.6617cm Y= -0.3212cm Z= 3.8235cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.990601	0.045063	0.129149
-0.041518	0.998687	-0.030017
-0.130332	0.024373	0.991171

HRV # 0240

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -18.9848cm Y= -0.1718cm Z= 2.0138cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.982062	-0.037795	0.184733
0.028403	0.998178	0.053227
-0.186408	-0.047025	0.981346

HRV # 0241

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -18.1043cm Y= -0.5658cm Z= 5.8621cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.997620	0.068826	0.004151
-0.068312	0.994760	-0.076067
-0.009364	0.075602	0.997094

HRV # 0242

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -17.9545cm Y= -2.4086cm Z= 4.2884cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.985006	0.117710	0.126123
-0.117294	0.993039	-0.010743
-0.126510	-0.004211	0.991956

HRV # 0243

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -17.1260cm Y= 1.0928cm Z= 4.3546cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.993706	-0.057820	0.095949
0.056713	0.998289	0.014230
-0.096607	-0.008698	0.995285

HRV # 0245

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -19.5921cm Y= -0.1332cm Z= 3.3402cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.985944	-0.020871	0.165767
0.016782	0.999520	0.026030
-0.166231	-0.022882	0.985821

HRV # 0246

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -17.5506cm Y= 0.0605cm Z= 5.9785cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.999634	-0.013221	-0.023598
0.013033	0.999882	-0.008112
0.023702	0.007801	0.999689

HRV # 0247

**T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN**

**X= -17.6736cm   Y= 0.3493cm   Z= 3.1673cm**

**T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM**

<b>0.978635</b>	<b>0.015629</b>	<b>0.205009</b>
<b>0.000959</b>	<b>0.996749</b>	<b>-0.080565</b>
<b>-0.205602</b>	<b>0.079040</b>	<b>0.975439</b>

Object Space Reference System is Rectangular

Rotation angles are Photo-to-Object

Complete Triangulation process is requested

Error Propagation is requested

[Eigenvector/Eigenvalue output]

Unit Variance will be based on constrained camera parameters

All Image Residuals will be listed

Triangulated Object Coordinates will not be saved

Adjusted Camera Station Parameters will be saved



**This Document Contains Missing  
Page/s That Are Unavailable In  
The Original Document**

FRAME A/Pprism

PRINCIPAL DISTANCE = -1820.0000 mm

Std. Dev. of X = 0.7500 mm

Std. Dev. of Y = 0.7500 mm

CAMERA STATION PARAMETERS

P O S I T I O N		Std. Dev.	A T T I T U D E		Std. Dev.
			(Photo to Object)		
X =	0.6180 m	0.1000 m	OMEGA =	01 33 34.7990	01 00 0.0000
Y =	0.2070 m	0.1000 m	PHI =	- 25 59 9.1820	01 00 0.0000
Z =	1.6040 m	0.1000 m	KAPPA =	- 01 19 26.9420	01 00 0.0000

PLATE COORDINATES in millimeters

ID	X	Y	ID	X	Y
c3	-108.7733	120.0640	c13	-14.5547	123.0519
c4	104.6934	115.3344	c11	-118.1540	11.0636
c10	-17.2353	5.3470	c9	98.3659	-0.7794
c2	-114.5128	-93.9894	c12	-19.9543	-111.6611
c1	99.6819	-99.4433	cv1	-126.6205	154.7530
cv2	-72.3288	158.0377	cv3	-11.8062	160.3876
cv4	55.5835	162.2231	cv5	126.4267	164.3177
cv6	-132.3124	-130.7580	cv7	-76.8059	-139.1647
cv8	-16.4941	-148.0864	cv9	48.6984	-157.6482
cv10	118.9474	-167.8746	lam	72.7107	61.6900
ram	-65.5934	64.4032	lon	36.7835	103.5615
ron	-49.0790	104.0877	ltp	92.0672	42.1026
rtp	-124.5797	38.9765	ctp	-20.6030	117.8744
chin	-9.0220	-8.7193	ltuskF	147.5698	12.8076
ltuskM	180.5513	4.3056	rtuskF	-123.7788	20.2354
rtuskM	-142.9886	15.8420	rtuskR	-161.7258	11.5104
capLfF	87.6002	140.5863	capLfR	96.9226	89.9548
capRtF	-81.3890	139.6819	capRtR	-88.1473	94.4914
capCEN	-1.7931	169.2767			

NBDL H-P UNIX GIANT (11/90) :  
HRV # 0246

PAGE 2

FRAME A/Phrv45 same

NBDL H-P UNIX GIANT (11/90) :  
HRV # 0246

PAGE 3

FRAME LATHrv45 same

NBDL H-P UNIX GIANT (11/90) :  
HRV # 0246

PAGE 4

FRAME LATprism same

NBDL H-P UNIX GIANT (11/90) :  
HRV # 0246

PAGE 5

# ERROR WARNINGS

PASS POINTS APPEARING ON 1 PHOTO

cv1  
rtuskR

cv2

cv6

cv7

TRIANGULATED OBJECT POINTS

Ident	Position (meters)		Error Ellipsoid --->				Length (m)
ctp *0*	X =	0.0001	-6.178E-02	-8.899E-02	+9.941E-01		0.0003
	Y =	-0.0001	-6.918E-01	-7.141E-01	-1.069E-01		0.0003
	Z =	0.0000	+7.194E-01	-6.943E-01	-1.744E-02		0.0003
ltp *0*	X =	0.0888	-2.519E-01	-9.759E-02	+9.628E-01		0.0003
	Y =	0.0001	-3.698E-01	-9.097E-01	-1.890E-01		0.0003
	Z =	0.0635	+8.943E-01	-4.037E-01	+1.930E-01		0.0003
rtp *0*	X =	-0.0890	+1.242E-01	-1.409E-01	+9.822E-01		0.0003
	Y =	0.0001	-5.344E-02	-9.894E-01	-1.352E-01		0.0003
	Z =	0.0635	-9.908E-01	+3.571E-02	+1.304E-01		0.0003
Origin	X =	-0.0011	-4.186E-02	-2.834E-02	+9.987E-01		0.0029
	Y =	-0.0671	-9.977E-01	-5.168E-02	-4.329E-02		0.0019
	Z =	0.1666	+5.284E-02	-9.983E-01	-2.611E-02		0.0015
Rib_Lf	X =	0.0365	-9.863E-02	-4.723E-02	+9.940E-01		0.0026
	Y =	-0.0510	-9.891E-01	-1.055E-01	-1.032E-01		0.0017
	Z =	0.1560	+1.097E-01	-9.933E-01	-3.631E-02		0.0013
Rib_Rt	X =	-0.0379	+3.763E-03	-4.485E-02	+9.990E-01		0.0027
	Y =	-0.0573	+1.000E+00	+4.085E-03	-3.583E-03		0.0018
	Z =	0.1564	+3.920E-03	-9.990E-01	-4.486E-02		0.0014
lneckB	X =	0.0648	-6.518E-01	-1.441E-01	+7.446E-01		0.0165
	Y =	-0.0068	-6.900E-01	-2.948E-01	-6.611E-01		0.0022
	Z =	0.1775	+3.147E-01	-9.446E-01	+9.275E-02		0.0016
lneckT	X =	0.0535	-6.434E-01	-2.030E-01	+7.381E-01		0.0168
	Y =	0.0343	-6.500E-01	-3.645E-01	-6.669E-01		0.0022
	Z =	0.1886	+4.044E-01	-9.088E-01	+1.026E-01		0.0017
rneckB	X =	-0.0718	-5.371E-01	-1.373E-01	+8.323E-01		0.0157
	Y =	-0.0267	-8.168E-01	-1.618E-01	-5.538E-01		0.0027
	Z =	0.2090	+2.107E-01	-9.772E-01	-2.522E-02		0.0019
rneckT	X =	-0.0797	-5.296E-01	-2.187E-01	+8.195E-01		0.0167
	Y =	0.0239	-7.478E-01	-3.357E-01	-5.728E-01		0.0028
	Z =	0.2196	+4.004E-01	-9.162E-01	+1.426E-02		0.0020
lneckBx	X =	0.0641	+4.438E-01	-2.899E-02	+8.956E-01		0.0169
	Y =	0.0016	+8.915E-01	-8.697E-02	-4.446E-01		0.0023
	Z =	0.1791	+9.078E-02	+9.958E-01	-1.275E-02		0.0017
lneckTx	X =	0.0580	+4.498E-01	-9.227E-02	+8.883E-01		0.0181
	Y =	0.0458	+8.476E-01	-2.695E-01	-4.572E-01		0.0023
	Z =	0.1766	+2.815E-01	+9.586E-01	-4.301E-02		0.0017
rneckBx	X =	-0.0741	+5.965E-01	+6.606E-03	+8.026E-01		0.0170
	Y =	-0.0227	-7.968E-01	+1.253E-01	+5.911E-01		0.0024
	Z =	0.1886	-9.669E-02	-9.921E-01	+8.003E-02		0.0018

TRIANGULATED OBJECT POINTS

Ident	Position (meters)	Error Ellipsoid --->	Length (m)
sternum	X = -0.0014	-6.136E-01 -3.879E-03 +7.896E-01	0.0151
	Y = -0.1094	-7.893E-01 +2.828E-02 -6.133E-01	0.0030
	Z = 0.2047	-1.995E-02 -9.996E-01 -2.041E-02	0.0020
SpineBot	X = -0.0008	-3.278E-02 -5.340E-02 +9.980E-01	0.0020
	Y = -0.0564	-9.985E-01 -4.283E-02 -3.509E-02	0.0012
	Z = 0.1042	-4.462E-02 +9.977E-01 +5.192E-02	0.0010
SpineTop	X = -0.0012	-3.556E-02 -5.649E-02 +9.978E-01	0.0020
	Y = -0.0525	-9.982E-01 -4.609E-02 -3.819E-02	0.0012
	Z = 0.1062	-4.815E-02 +9.973E-01 +5.475E-02	0.0010
lf_shold	X = 0.1449	-6.292E-01 -4.279E-02 +7.760E-01	0.0280
	Y = -0.0749	-7.771E-01 +1.914E-02 -6.290E-01	0.0015
	Z = 0.0366	+1.206E-02 -9.989E-01 -4.530E-02	0.0015
rt_shold	X = -0.1069	-4.242E-01 -6.200E-02 +9.034E-01	0.0169
	Y = -0.0697	-6.487E-01 +7.169E-01 -2.554E-01	0.0014
	Z = 0.0706	+6.318E-01 +6.944E-01 +3.443E-01	0.0012
rt_sholx	X = -0.1233	+5.634E-01 +6.231E-02 +8.238E-01	0.0260
	Y = -0.0712	-8.257E-01 +7.290E-03 +5.641E-01	0.0015
	Z = 0.0660	+2.914E-02 -9.980E-01 +5.555E-02	0.0014
spine_bb	X = 0.0010	-3.510E-02 -5.788E-02 +9.977E-01	0.0019
	Y = -0.0523	-9.981E-01 -4.848E-02 -3.793E-02	0.0012
	Z = 0.0971	-5.056E-02 +9.971E-01 +5.607E-02	0.0009
sternumx	X = 0.0092	+5.207E-01 +1.234E-01 +8.448E-01	0.0161
	Y = -0.1026	-8.346E-01 -1.345E-01 +5.341E-01	0.0030
	Z = 0.2146	+1.796E-01 -9.832E-01 +3.296E-02	0.0020

SUMMARY STATISTICS FOR OBJECT POINTS

RMS For Standard Deviations

Count = 18	X =	0.0088 meters
Count = 18	Y =	0.0023 meters
Count = 18	Z =	0.0127 meters

C O R R E C T I O N S      A P P L I E D      T O      O B J E C T      C O N T R O L

          X =           0.0001 m  
ctp       Y =           -0.0001 m  
          Z =           0.0000 m

          X =           -0.0001 m  
ltp       Y =           0.0001 m  
          Z =           0.0000 m

          X =           -0.0001 m  
ltp       Y =           0.0001 m  
          Z =           0.0000 m

          X =           -0.0001 m  
rtp       Y =           0.0001 m  
          Z =           0.0000 m

X ....	Number of Components =	3	RMS =	0.0001 meters
Y ....	Number of Components =	3	RMS =	0.0001 meters
Z ....	Number of Components =	3	RMS =	0.0000 meters



A N T H R O P O M E T R Y    O U T P U T

T-PLATE ORIGIN WITH RESPECT TO BODY ANATOMICAL ORIGIN

X= -17.6736cm    Y=    0.3493cm    Z=    3.1673cm

T-PLATE ORIENTATION WITH RESPECT TO BODY ANATOMICAL SYSTEM

0.978635	0.015629	0.205009
0.000959	0.996749	-0.080565
-0.205602	0.079040	0.975439

C A M E R A     S T A T I O N S     C O R R E C T I O N S

----- P O S I T I O N -----     ----- A T T I T U D E -----

          X           Y           Z                   Omega           Phi           Kappa

Iteration   1

A/Phrv45	0.0155	-0.0176	-0.0301 m.	-0.023089	-0.024483	-0.014991
A/Pprism	0.0088	-0.0082	-0.0048 m.	-0.005967	-0.006340	-0.002185
LAThrv45	0.0108	-0.0074	0.0066 m.	-0.016710	-0.015496	0.010755
LATprism	0.0027	-0.0020	0.0061 m.	-0.016757	-0.009864	0.015373

Provisional Weighted Sum of Squares =   257.913

Iteration   2

A/Phrv45	-0.0005	0.0003	-0.0003 m.	-0.000537	0.000120	-0.000625
A/Pprism	0.0000	0.0001	-0.0001 m.	0.000030	-0.000018	0.000019
LAThrv45	0.0001	0.0000	-0.0002 m.	0.000268	-0.000085	-0.000209
LATprism	0.0001	0.0000	0.0000 m.	0.000529	-0.000044	-0.000499

Provisional Weighted Sum of Squares =   113.545

Iteration   3

A/Phrv45	0.0000	0.0000	0.0000 m.	-0.000005	0.000004	-0.000004
A/Pprism	0.0000	0.0000	0.0000 m.	0.000000	0.000001	0.000000
LAThrv45	0.0000	0.0000	0.0000 m.	-0.000001	0.000001	0.000001
LATprism	0.0000	0.0000	0.0000 m.	-0.000003	0.000001	0.000002

Provisional Weighted Sum of Squares =   105.258

TRIANGULATED IMAGE POINTS RESIDUALS  
 (in micrometers)

lam	A/Phrv45	A/Pprism	LAThrv45	LATprism
	-699	774	-320	-70
	648	-479	666	-828
ram	A/Phrv45	A/Pprism	LAThrv45	LATprism
	-214	-131	364	-342
	10	-121	-174	205
lon	A/Pprism	A/Phrv45	LAThrv45	LATprism
	-20	-16	32	-62
	248	-119	-297	187
ron	A/Pprism	LAThrv45	A/Phrv45	LATprism
	319	-331	60	289
	-299	213	-261	260
rtp	A/Phrv45	A/Pprism	LATprism	
	1161	-647	526	
	-160	-101	245	
ctp	A/Phrv45	A/Pprism	LAThrv45	LATprism
	-402	310	46	-252
	-153	-748	405	314
chin	A/Pprism	A/Phrv45	LAThrv45	LATprism
	220	-176	-99	-36
	537	284	-532	-155
ltuskF	A/Pprism	LAThrv45	A/Phrv45	LATprism
	-225	-136	335	247
	108	213	-854	600
capLfF	A/Phrv45	A/Pprism	LAThrv45	LATprism
	-19	-279	242	-188
	444	429	-474	-370
capLfR	A/Pprism	A/Phrv45	LAThrv45	LATprism
	-736	732	49	451
	-77	512	54	-431
capRtF	A/Pprism	A/Phrv45	LAThrv45	LATprism
	230	-145	173	-150
	-993	-365	-55	1017
capRtR	A/Pprism	LAThrv45	A/Phrv45	LATprism
	2	461	-422	-430
	-832	-85	248	439
capCEN	A/Pprism	LAThrv45	A/Phrv45	LATprism
	-65	359	-210	-409
	-121	111	-211	124

TRIANGULATED IMAGE POINTS RESIDUALS  
(in micrometers)

c3 *0*	A/Pprism		
	-536		
	-122		
c13 *0*	LATprism	A/Pprism	
	588	-222	
	733	384	
c4 *0*	A/Pprism		
	284		
	93		
c11 *0*	A/Pprism		
	-566		
	347		
c10 *0*	A/Pprism	LATprism	
	-206	-230	
	332	-218	
c9 *0*	LATprism	A/Pprism	
	467	503	
	95	-143	
c2 *0*	A/Pprism		
	347		
	44		
c12 *0*	LATprism	A/Pprism	
	-567	-79	
	-1790	189	
c1 *0*	A/Pprism		
	107		
	-366		
cv3	LATprism	A/Pprism	
	13	51	
	205	-248	
cv4	LATprism	A/Pprism	
	-28	-97	
	-473	505	
cv5	-LATprism	A/Pprism	
	-47	-145	
	-856	810	
cv8	LATprism	A/Pprism	
	110	250	
	-950	1158	

TRIANGULATED IMAGE POINTS RESIDUALS  
 (in micrometers)

cv9	LATprism A/Pprism		
	3 7		
	-33 35		
cv10	LATprism A/Pprism		
	-108 -190		
	959 -915		
ltp	LAThrv45 A/Pprism		
	25 -6		
	264 -294		
ltuskM	A/Pprism LATprism LAThrv45		
	187 265 -362		
	-476 409 106		
rtuskF	LAThrv45 LATprism A/Pprism		
	-559 346 540		
	-265 -81 524		
rtuskM	LATprism A/Pprism		
	6 -7		
	-381 599		
ltuskR	LAThrv45 LATprism		
	-1 -10		
	-103 98		
c5 *0*	LATprism		
	1324		
	-1035		
c8 *0*	LATprism		
	-550		
	-489		
c6 *0*	LATprism		
	142		
	1141		
c7 *0*	LATprism		
	-1259		
	1091		

Weighted Sum of Squares (Camera) =	9.0
Weighted Sum of Squares (Object) =	10.6
Weighted Sum of Squares (Plates) =	69.5
Weighted Sum of Squares (Total) =	89.0
Degrees of Freedom..... =	112

a posteriori Variance of Unit Weight = 0.795

TRIANGULATED CAMERA STATIONS  
 (Photo to Object)

Ident	Position	Error Ellipsoid	--->	Length
A/Phrv45	X =	1.3610 m.	-0.3187 +0.0866 +0.9439	0.0069 m.
	Y =	0.3547 m.	-0.1760 -0.9839 +0.0308	0.0059 m.
	Z =	0.8256 m.	-0.9314 +0.1563 -0.3288	0.0048 m.
	Omega =	14 00 40.6501		00 23 27.3083
	Attitude: Phi =	66 05 36.2063	Std Dev:	00 14 51.3858
	Kappa =	07 07 17.5617		00 21 33.5212
A/Pprism	X =	0.6268 m.	-0.7479 -0.0299 +0.6631	0.0036 m.
	Y =	0.1988 m.	-0.0792 +0.9959 -0.0444	0.0029 m.
	Z =	1.5991 m.	+0.6590 +0.0858 +0.7472	0.0027 m.
	Omega =	01 13 10.2479		00 07 31.5754
	Attitude: Phi =	26 21 0.4450	Std Dev:	00 07 36.5272
	Kappa =	01 26 53.6600		00 06 36.3141
LAThrv45	X =	-0.3372 m.	+0.8412 +0.0527 +0.5382	0.0025 m.
	Y =	0.1896 m.	+0.3811 +0.6483 -0.6592	0.0019 m.
	Z =	0.7904 m.	-0.3836 +0.7596 +0.5252	0.0017 m.
	Omega =	06 14 47.5086		00 10 17.6096
	Attitude: Phi =	25 03 18.3900	Std Dev:	00 12 20.4255
	Kappa =	06 32 24.3338		00 09 36.9996
LATprism	X =	-0.6522 m.	+0.3665 -0.0303 +0.9299	0.0018 m.
	Y =	0.1410 m.	-0.1973 -0.9793 +0.0458	0.0013 m.
	Z =	0.4651 m.	-0.9093 +0.2002 +0.3648	0.0012 m.
	Omega =	00 06 0.5142		00 13 58.9638
	Attitude: Phi =	65 14 31.8184	Std Dev:	00 08 44.4022
	Kappa =	00 31 25.9699		00 13 1.5323

SUMMARY STATISTICS FOR CAMERA STATION

RMS For Standard Deviations

Count = 4	X =	0.0033 m.	Omega =	00 15 4.1210
	Y =	0.0035 m.	Phi =	00 11 15.6873
	Z =	0.0039 m.	Kappa =	00 13 52.7640



TRIANGULATED OBJECT POINTS

Ident		Position (meters)	Error Ellipsoid --->	Length (m)
c1	*0*	X = -0.0470	+3.908E-01 +8.589E-02 +9.164E-01	0.0004
		Y = 0.0510	-8.998E-01 +2.456E-01 +3.607E-01	0.0004
		Z = 0.0194	-1.941E-01 -9.656E-01 +1.733E-01	0.0004
c2	*0*	X = -0.2348	+4.958E-01 +8.520E-02 +8.643E-01	0.0004
		Y = 0.0508	-8.663E-01 +1.180E-01 +4.853E-01	0.0004
		Z = 0.0973	-6.065E-02 -9.893E-01 +1.323E-01	0.0004
c3	*0*	X = -0.2345	+4.973E-01 -3.184E-02 +8.670E-01	0.0004
		Y = 0.2541	+8.371E-01 +2.803E-01 -4.699E-01	0.0004
		Z = 0.0971	-2.280E-01 +9.594E-01 +1.660E-01	0.0004
c4	*0*	X = -0.0470	+3.921E-01 -3.210E-02 +9.194E-01	0.0004
		Y = 0.2540	+9.032E-01 +2.033E-01 -3.781E-01	0.0004
		Z = 0.0195	-1.748E-01 +9.786E-01 +1.087E-01	0.0004
c5	*0*	X = 0.0233	-8.476E-01 -1.417E-01 +5.113E-01	0.0004
		Y = 0.2545	-5.302E-01 +1.869E-01 -8.270E-01	0.0004
		Z = 0.0568	+2.161E-02 -9.721E-01 -2.335E-01	0.0004
c6	*0*	X = 0.0193	-8.434E-01 +1.133E-01 +5.251E-01	0.0004
		Y = 0.0502	+5.314E-01 +3.201E-01 +7.844E-01	0.0004
		Z = 0.0469	-7.923E-02 +9.406E-01 -3.302E-01	0.0004
c7	*0*	X = 0.0973	-9.496E-01 +1.143E-01 +2.919E-01	0.0004
		Y = 0.0502	+2.845E-01 -7.672E-02 +9.556E-01	0.0004
		Z = 0.2353	+1.316E-01 +9.905E-01 +4.034E-02	0.0004
c8	*0*	X = 0.0972	-9.461E-01 -1.426E-01 +2.908E-01	0.0004
		Y = 0.2542	-2.908E-01 -2.141E-02 -9.565E-01	0.0004
		Z = 0.2350	+1.427E-01 -9.895E-01 -2.122E-02	0.0004
c9	*0*	X = 0.0502	-9.868E-01 -1.842E-02 +1.610E-01	0.0002
		Y = 0.1524	+1.602E-01 +3.867E-02 +9.863E-01	0.0002
		Z = 0.2541	-2.440E-02 +9.991E-01 -3.520E-02	0.0002
c10	*0*	X = -0.0825	-9.755E-01 -2.033E-02 +2.190E-01	0.0002
		Y = 0.1524	-2.187E-01 -1.825E-02 -9.756E-01	0.0002
		Z = 0.1991	-2.383E-02 +9.996E-01 -1.335E-02	0.0002
c11	*0*	X = -0.2151	+5.007E-01 +2.762E-02 +8.652E-01	0.0002
		Y = 0.1524	-7.539E-01 -4.772E-01 +4.515E-01	0.0002
		Z = 0.1441	+4.253E-01 -8.784E-01 -2.181E-01	0.0002
c12	*0*	X = -0.0824	+9.436E-01 -1.660E-01 -2.865E-01	0.0002
		Y = 0.0511	-3.129E-01 -1.642E-01 -9.355E-01	0.0002
		Z = 0.1992	-1.083E-01 -9.724E-01 +2.069E-01	0.0002
c13	*0*	X = -0.0825	+9.440E-01 +1.971E-01 -2.645E-01	0.0002
		Y = 0.2538	+2.935E-01 -1.360E-01 +9.462E-01	0.0002
		Z = 0.1990	-1.506E-01 +9.709E-01 +1.862E-01	0.0002

TRIANGULATED OBJECT POINTS

Ident	Position (meters)	Error Ellipsoid --->	Length (m)
ctp	X = -0.0383	-9.889E-01 -1.179E-01 +9.016E-02	0.0006
	Y = 0.2450	-9.945E-02 +7.538E-02 -9.922E-01	0.0005
	Z = 0.2958	+1.102E-01 -9.902E-01 -8.627E-02	0.0004
cv3	X = -0.0819	-8.920E-01 -2.429E-01 +3.813E-01	0.0007
	Y = 0.2855	-4.147E-01 +1.035E-01 -9.041E-01	0.0006
	Z = 0.1960	+1.802E-01 -9.645E-01 -1.931E-01	0.0005
cv4	X = -0.0044	+9.669E-01 +1.868E-01 -1.740E-01	0.0007
	Y = 0.2856	+2.011E-01 -1.375E-01 +9.699E-01	0.0006
	Z = 0.2261	-1.572E-01 +9.727E-01 +1.705E-01	0.0005
cv5	X = 0.0723	+9.891E-01 +1.341E-01 +6.105E-02	0.0007
	Y = 0.2851	-4.477E-02 -1.213E-01 +9.916E-01	0.0007
	Z = 0.2587	-1.404E-01 +9.835E-01 +1.139E-01	0.0005
cv8	X = -0.0795	-8.893E-01 +2.111E-01 +4.057E-01	0.0007
	Y = 0.0202	+4.384E-01 +1.407E-01 +8.877E-01	0.0006
	Z = 0.1962	+1.303E-01 +9.673E-01 -2.177E-01	0.0005
cv9	X = -0.0031	+9.651E-01 -1.546E-01 -2.113E-01	0.0007
	Y = 0.0196	-2.377E-01 -1.792E-01 -9.547E-01	0.0006
	Z = 0.2273	-1.097E-01 -9.716E-01 +2.097E-01	0.0005
lam	X = -0.0279	-6.088E-01 -8.611E-02 +7.886E-01	0.0005
	Y = 0.2021	-7.880E-01 -4.903E-02 -6.137E-01	0.0005
	Z = 0.1319	+9.151E-02 -9.951E-01 -3.800E-02	0.0004
lon	X = -0.0283	-8.993E-01 -1.442E-01 +4.129E-01	0.0005
	Y = 0.2371	-4.224E-01 +4.123E-02 -9.055E-01	0.0005
	Z = 0.2091	+1.135E-01 -9.887E-01 -9.797E-02	0.0004
ltp	X = 0.0438	-9.374E-02 +1.363E-02 +9.955E-01	0.0009
	Y = 0.1866	+9.952E-01 +2.917E-02 +9.332E-02	0.0006
	Z = 0.2551	-2.776E-02 +9.995E-01 -1.630E-02	0.0005
ram	X = -0.1448	-4.739E-02 -5.937E-02 +9.971E-01	0.0005
	Y = 0.2021	-9.928E-01 -1.068E-01 -5.354E-02	0.0005
	Z = 0.1736	-1.096E-01 +9.925E-01 +5.388E-02	0.0004
ron	X = -0.0958	+9.898E-01 +1.339E-01 -4.928E-02	0.0005
	Y = 0.2356	+6.467E-02 -1.131E-01 +9.915E-01	0.0005
	Z = 0.2355	-1.271E-01 +9.845E-01 +1.206E-01	0.0004
rtp	X = -0.1256	+9.717E-01 +5.596E-02 +2.293E-01	0.0007
	Y = 0.1799	+2.216E-01 +1.177E-01 -9.680E-01	0.0005
	Z = 0.3103	-8.116E-02 +9.915E-01 +1.020E-01	0.0004
chin	X = -0.0464	-9.928E-01 -1.145E-02 +1.195E-01	0.0005
	Y = 0.1430	-1.184E-01 -6.899E-02 -9.906E-01	0.0005
	Z = 0.2539	-1.959E-02 +9.976E-01 -6.713E-02	0.0004

TRIANGULATED OBJECT POINTS

Ident	Position (meters)	Error Ellipsoid --->	Length (m)
cv10	X = 0.0732	+9.949E-01 -1.003E-01 +8.758E-03	0.0007
	Y = 0.0193	+8.988E-03 +1.751E-01 +9.845E-01	0.0007
	Z = 0.2593	+1.003E-01 +9.794E-01 -1.752E-01	0.0005
capCEN	X = -0.0647	+8.678E-01 +2.523E-01 -4.281E-01	0.0005
	Y = 0.2922	-4.661E-01 +1.147E-01 -8.772E-01	0.0005
	Z = 0.2118	+1.722E-01 -9.608E-01 -2.172E-01	0.0004
capLfF	X = -0.0139	-6.646E-01 -2.250E-01 +7.125E-01	0.0006
	Y = 0.2721	-7.341E-01 +1.872E-02 -6.788E-01	0.0005
	Z = 0.1377	+1.394E-01 -9.742E-01 -1.776E-01	0.0004
capLfR	X = -0.0218	-4.601E-01 -1.289E-01 +8.785E-01	0.0006
	Y = 0.2283	-8.811E-01 -5.569E-02 -4.696E-01	0.0005
	Z = 0.0971	+1.094E-01 -9.901E-01 -8.792E-02	0.0004
capRtF	X = -0.1503	-4.370E-02 +1.739E-01 -9.838E-01	0.0006
	Y = 0.2671	+9.786E-01 +2.058E-01 -7.092E-03	0.0005
	Z = 0.1950	+2.012E-01 -9.630E-01 -1.792E-01	0.0004
capRtR	X = -0.1743	-2.505E-02 -1.033E-01 +9.943E-01	0.0006
	Y = 0.2281	-9.862E-01 -1.603E-01 -4.150E-02	0.0005
	Z = 0.1627	-1.637E-01 +9.817E-01 +9.786E-02	0.0004
ltuskF	X = 0.0366	-6.066E-01 -6.847E-04 +7.950E-01	0.0006
	Y = 0.1613	+7.929E-01 +7.251E-02 +6.050E-01	0.0005
	Z = 0.1157	-5.806E-02 +9.974E-01 -4.344E-02	0.0004
ltuskM	X = 0.0492	-4.071E-01 +1.209E-02 +9.133E-01	0.0008
	Y = 0.1530	+9.132E-01 +2.323E-02 +4.068E-01	0.0006
	Z = 0.0662	-1.630E-02 +9.997E-01 -2.050E-02	0.0005
ltuskR	X = 0.0619	-7.345E-01 +1.433E-02 +6.784E-01	0.0021
	Y = 0.1442	+6.786E-01 +2.666E-02 +7.341E-01	0.0007
	Z = 0.0156	-7.571E-03 +9.995E-01 -2.931E-02	0.0006
rtuskF	X = -0.1806	-6.375E-02 +3.157E-02 +9.975E-01	0.0006
	Y = 0.1626	-9.974E-01 -3.479E-02 -6.264E-02	0.0005
	Z = 0.2120	-3.273E-02 +9.989E-01 -3.371E-02	0.0004
rtuskM	X = -0.2192	-8.321E-01 -1.915E-02 +5.543E-01	0.0007
	Y = 0.1573	-5.538E-01 -2.772E-02 -8.322E-01	0.0006
	Z = 0.1810	-3.130E-02 +9.994E-01 -1.246E-02	0.0005

S U M M A R Y   S T A T I S T I C S   F O R   O B J E C T   P O I N T S

RMS For Standard Deviations

Count = 24	X =	0.0007 meters
Count = 24	Y =	0.0004 meters
Count = 24	Z =	0.0007 meters

C O R R E C T I O N S      A P P L I E D      T O      O B J E C T      C O N T R O L

c10    X =        0.0000 m  
       Y =        0.0000 m  
       Z =        0.0000 m

c1     X =       -0.0001 m  
       Y =        0.0002 m  
       Z =        0.0000 m

c2     X =       -0.0001 m  
       Y =        0.0000 m  
       Z =        0.0001 m

c3     X =        0.0002 m  
       Y =        0.0001 m  
       Z =       -0.0001 m

c5     X =       -0.0004 m  
       Y =        0.0005 m  
       Z =       -0.0005 m

c7     X =        0.0001 m  
       Y =       -0.0006 m  
       Z =        0.0006 m

c9     X =       -0.0001 m  
       Y =        0.0000 m  
       Z =        0.0000 m

c11    X =        0.0001 m  
       Y =        0.0000 m  
       Z =        0.0000 m

c12    X =        0.0001 m  
       Y =        0.0003 m  
       Z =        0.0001 m

c13    X =        0.0000 m  
       Y =       -0.0002 m  
       Z =       -0.0001 m

c4     X =       -0.0001 m  
       Y =        0.0000 m  
       Z =        0.0001 m

c6     X =       -0.0001 m  
       Y =       -0.0006 m  
       Z =        0.0000 m

c8     X =        0.0000 m  
       Y =        0.0002 m  
       Z =        0.0003 m

X .... Number of Components = 13  
 Y .... Number of Components = 13  
 Z .... Number of Components = 13

RMS =        0.0002 meters  
 RMS =        0.0003 meters  
 RMS =        0.0003 meters

A N T H R O P O M E T R Y    O U T P U T

T-PLATE ORIGIN WITH RESPECT TO HEAD ANATOMICAL ORIGIN

X= 15.4854cm    Y= -0.1917cm    Z= -2.4835cm

T-PLATE ORIENTATION WITH RESPECT TO HEAD ANATOMICAL SYSTEM

-0.602996	0.026833	-0.797293
0.028161	0.999527	0.012342
0.797247	-0.015010	-0.603467

Object Space Reference System is Rectangular

Rotation angles are Photo-to-Object

Complete Triangulation process is requested

Error Propagation is requested

[Eigenvector/Eigenvalue output]

Unit Variance will be based on constrained camera parameters

All Image Residuals will be listed

Triangulated Object Coordinates will not be saved

Adjusted Camera Station Parameters will be saved

FRAME LfEyLfSh

PRINCIPAL DISTANCE = -889.0000 mm  
Std. Dev. of X = 1.0000 mm  
Std. Dev. of Y = 1.0000 mm

CAMERA STATION PARAMETERS

P O S I T I O N		Std. Dev.	A T T I T U D E (Photo to Object)		Std. Dev.
X =	-0.4540 m	0.0400 m	OMEGA = -	09 28 11.6650	02 00 0.0000
Y =	-0.1010 m	0.0400 m	PHI =	33 37 5.3610	02 00 0.0000
Z =	0.6980 m	0.0400 m	KAPPA =	05 34 55.8970	05 00 0.0000

PLATE COORDINATES in millimeters

ID	X	Y	ID	X	Y
Origin	99.1238	-43.2609	Rib_Lf	123.2400	-22.8540
Rib_Rt	50.8726	-30.6428	SpineTop	51.3787	-33.8122
SpineBot	50.7604	-39.4013	spine_bb	47.0025	-35.9258
sternum	136.0849	-91.5953	lf_shold	130.3984	-60.5963
rt_shold	-76.5308	-64.5011	ltp	94.8383	17.6056
rtp	-68.6747	17.8384	ctp	-18.1678	7.5425
lneckT	152.7598	87.4338	lneckB	159.7464	35.0096
rneckT	44.8939	89.8550	rneckB	52.5732	16.9683

FRAME RtEyLfSh same

FRAME LfEyRtSh same

FRAME RtEyRtSh same

E R R O R W A R N I N G S

PASS POINTS APPEARING ON 1 PHOTO

rneckTx lf\_sholx



C A M E R A S T A T I O N S C O R R E C T I O N S

----- P O S I T I O N ----- ----- A T T I T U D E -----

X Y Z Omega Phi Kappa

Iteration 1

LfEyLfSh	0.0025	-0.0151	0.0139 m.	-0.026937	-0.016773	0.019630
RtEyLfSh	0.0007	-0.0157	0.0119 m.	-0.025419	-0.010306	0.017636
LfEyRtSh	0.0093	-0.0140	-0.0131 m.	-0.021530	-0.015926	-0.015962
RtEyRtSh	-0.0021	-0.0128	-0.0118 m.	-0.026312	-0.005633	-0.024661

Provisional Weighted Sum of Squares = 140.584

Iteration 2

LfEyLfSh	0.0002	-0.0003	-0.0002 m.	0.000233	-0.000255	-0.000341
RtEyLfSh	0.0002	-0.0004	-0.0004 m.	-0.000043	-0.000210	-0.000158
LfEyRtSh	-0.0001	0.0000	-0.0006 m.	-0.000729	-0.000113	-0.000705
RtEyRtSh	0.0002	0.0001	-0.0004 m.	-0.000347	-0.000020	-0.000283

Provisional Weighted Sum of Squares = 111.744

Iteration 3

LfEyLfSh	0.0000	0.0000	0.0000 m.	0.000001	-0.000025	-0.000004
RtEyLfSh	0.0000	0.0000	0.0000 m.	0.000015	-0.000023	-0.000003
LfEyRtSh	0.0000	0.0000	0.0000 m.	-0.000035	-0.000031	-0.000014
RtEyRtSh	0.0000	0.0000	0.0000 m.	0.000004	-0.000013	-0.000018

Provisional Weighted Sum of Squares = 100.229

Iteration 4

LfEyLfSh	0.0000	0.0000	0.0000 m.	0.000000	0.000001	0.000000
RtEyLfSh	0.0000	0.0000	0.0000 m.	-0.000001	0.000000	0.000000
LfEyRtSh	0.0000	0.0000	0.0000 m.	-0.000001	-0.000002	0.000000
RtEyRtSh	0.0000	0.0000	0.0000 m.	0.000000	0.000001	-0.000001

Provisional Weighted Sum of Squares = 100.227

TRIANGULATED IMAGE POINTS RESIDUALS  
 (in micrometers)

Origin	LfEyLfSh	RtEyLfSh	LfEyRtSh	RtEyRtSh
	-1009	688	-297	477
	1029	1111	-584	-1678
Rib_Lf	LfEyLfSh	RtEyLfSh	LfEyRtSh	RtEyRtSh
	-102	133	622	-675
	106	-890	1165	-430
Rib_Rt	RtEyLfSh	LfEyLfSh	LfEyRtSh	RtEyRtSh
	-118	1078	-674	-87
	-3046	-2489	3335	2759
SpineTop	RtEyLfSh	LfEyRtSh	LfEyLfSh	RtEyRtSh
	-34	-209	-111	344
	1026	-532	100	-625
SpineBot	LfEyLfSh	RtEyLfSh	LfEyRtSh	RtEyRtSh
	53	-414	-230	550
	800	1420	-825	-1454
spine_bb	LfEyLfSh	RtEyLfSh	LfEyRtSh	RtEyRtSh
	104	-511	255	88
	1104	1021	-978	-1210
sternum	LfEyLfSh	RtEyLfSh		
	75	-60		
	-435	446		
lf_shold	LfEyLfSh	RtEyLfSh		
	-86	69		
	487	-498		
rt_shold	RtEyLfSh	LfEyLfSh		
	-8	10		
	60	-59		
ltp *0*	LfEyLfSh	RtEyLfSh	LfEyRtSh	RtEyRtSh
	384	447	129	324
	674	-1175	-103	-273
rtp *0*	LfEyLfSh	LfEyRtSh	RtEyLfSh	RtEyRtSh
	-90	824	-149	647
	282	-1477	1351	-1405
ctp *0*	LfEyRtSh	LfEyLfSh	RtEyLfSh	RtEyRtSh
	-740	-348	-10	-1339
	2404	-1329	-1069	1972
lneckT	LfEyLfSh	RtEyLfSh		
	193	-156		
	-973	992		

TRIANGULATED IMAGE POINTS RESIDUALS  
 (in micrometers)

lneckB	RtEyLfSh	LfEyLfSh
	-72	90
	482	-472
rneckT	LfEyLfSh	RtEyLfSh
	-142	114
	701	-713
rneckB	LfEyLfSh	RtEyLfSh
	-94	76
	491	-501
sternumx	LfEyRtSh	RtEyRtSh
	91	-111
	-709	706
rt_sholx	RtEyRtSh	LfEyRtSh
	-169	141
	1088	-1094
lneckTx	LfEyRtSh	RtEyRtSh
	89	-105
	-690	687
lneckBx	LfEyRtSh	RtEyRtSh
	60	-72
	-470	469
rneckBx	LfEyRtSh	RtEyRtSh
	-77	91
	598	-594

Weighted Sum of Squares (Camera) =	3.9
Weighted Sum of Squares (Object) =	0.9
Weighted Sum of Squares (Plates) =	94.4
Weighted Sum of Squares (Total) =	99.2
Degrees of Freedom..... =	66

a posteriori Variance of Unit Weight = 1.502

TRIANGULATED CAMERA STATIONS  
 (Photo to Object)

Ident	Position	Error Ellipsoid	--->	Length
LfEyLfSh	X =	-0.4513 m.	+0.4197 +0.0111 +0.9076	0.0126 m.
	Y =	-0.1165 m.	-0.0871 +0.9958 +0.0281	0.0078 m.
	Z =	0.7117 m.	+0.9035 +0.0908 -0.4189	0.0059 m.
	Attitude:	Omega =- 10 59 59.4595	Std Dev: 00 46 42.3820	
	Phi = 32 38 28.0867	Std Dev: 00 45 45.4494		
	Kappa = 06 41 13.8430		00 37 41.2801	
RtEyLfSh	X =	-0.3941 m.	+0.5162 +0.0662 +0.8539	0.0126 m.
	Y =	-0.1110 m.	-0.1183 +0.9930 -0.0055	0.0082 m.
	Z =	0.7626 m.	+0.8483 +0.0982 -0.5204	0.0059 m.
	Attitude:	Omega =- 08 45 42.5924	Std Dev: 00 47 24.2431	
	Phi = 34 30 19.8861	Std Dev: 00 45 45.8510		
	Kappa = 04 23 53.1196		00 38 33.6183	
LfEyRtSh	X =	0.3433 m.	-0.6552 +0.0448 +0.7541	0.0134 m.
	Y =	-0.0210 m.	-0.1390 -0.9884 -0.0620	0.0090 m.
	Z =	0.8163 m.	-0.7425 +0.1454 -0.6538	0.0063 m.
	Attitude:	Omega =- 00 52 21.6863	Std Dev: 00 46 9.0630	
	Phi =- 30 57 48.5047	Std Dev: 00 50 40.5485		
	Kappa = 00 37 40.0242		00 35 29.6971	
RtEyRtSh	X =	0.4101 m.	-0.5521 +0.0166 +0.8336	0.0136 m.
	Y =	-0.0117 m.	-0.1410 -0.9873 -0.0737	0.0088 m.
	Z =	0.7768 m.	-0.8218 +0.1582 -0.5474	0.0064 m.
	Attitude:	Omega = 00 18 5.6923	Std Dev: 00 45 40.5535	
	Phi =- 29 29 51.1623	Std Dev: 00 50 52.2784		
	Kappa = 02 15 37.0526		00 34 37.5112	

SUMMARY STATISTICS FOR CAMERA STATION

RMS For Standard Deviations

Count = 4	X =	0.0088 m.	Omega =	00 46 29.3282
	Y =	0.0084 m.	Phi =	00 48 19.9366
	Z =	0.0114 m.	Kappa =	00 36 37.6055

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